

napur noticed by me establishes a new record of its distribution. I have observed its breeding since 1979 and have noticed as many as 35 nests at one time during June and July atop a defoliated Seesam tree in the marshes. During the breeding season the birds acquire beautiful plumage particularly the males in bright yellow gold, but the species is difficult to identify in the field in the nonbreeding plumage.

Besides these birds that have been regularly noted in Meerut region, there have been some others not noted in Delhi that were observed only once, and their irregular occurrence here has been very interesting. I am keeping an eye over their possible recurrence, if any, The following are such irregular migrants, if this word can be used for them.

1. Greyheaded Lapwing (365)  
(*Vanellus cinereus*)

Five of these winter migrants were observed near the marshes of Hastinapur in March 79 on a very cold, wet day. The birds were not immature for they had distinct pectoral band.

2. Pied Flycatcher Shrike (1065)  
(*Hemipus picatus*)

414, UTTAM BATIKA,  
W. KUTCHERY ROAD,  
MEERUT 250 001 (U.P.),  
April 30, 1984.

Two of these birds, never known to occur in the north of peninsular India, were observed in Hastinapur in Dec. 1980 in a small wooded patch overlapping the marshes. Their status in this region could at best be only occasional or stray.

3. Blackheaded Cuckoo-Shrike (1079)  
(*Coracina melanoptera*)

In August 1981 a pair of this cuckoo-shrike was observed feeding its two juveniles at the edge of forest at Hastinapur. The birds preferred *Acacia catechu* trees in and around which they hunted insects. The presence of juveniles though enigmatic indicates its breeding in or near this region and I am on the look out for its recurrence. If it proves resident bird here, it will be a new record of its distribution.

4. Blackbrowed Flycatcher Warbler (1614)  
(*Seicercus burkii*)

Several of these small warbler were observed in a small party, hunting insects, in the undergrowth at the edge of Hastinapur forest in March 1979. Their sighting was clear and unmistakable but their occurrence can at best be explained as stray in this region.

YADO MOHAN RAI

## 18. THE EFFECT OF GRAZING ON THE ABUNDANCE AND DIVERSITY OF BIRDS IN SCRUB VEGETATION AT NATHDWARA, RAJASTHAN

### INTRODUCTION

Grazing pressure on pasture and forest lands in India has increased steadily over the past century, with the rapid increase in the popu-

lations of cattle, sheep and goats (Chopra 1965, Centre for Science and Environment 1982). The intensity of grazing affects the structure and species composition of the vegetation (Puri 1965, Whyte 1968). If grazing

pressure has altered the vegetation of certain areas we may therefore expect long-term changes in their characteristic avifauna, perhaps leading to the local disappearance of certain species.

To study the effects on bird populations of changes in vegetation brought about by grazing I conducted observations on rocky, scrub-covered hillsides in the vicinity of Nathdwara, Rajasthan in November 1983. In this region many areas of rocky hillsides had been enclosed by stone walls about 1 m high to exclude grazing animals. The animals, principally cattle and goats, had free access to adjacent areas with similar slopes, aspects, soil and geology. All enclosures had been constructed during the past few years and no difference was apparent between the tree and shrub vegetation inside and outside the enclosures. However, the ground vegetation differed considerably between the two treatments.

By making a series of comparable observations in both enclosed and unenclosed areas I sought to demonstrate the effect that differences in the ground vegetation had on local bird populations. Because the only difference between enclosed and unenclosed areas was their accessibility to domestic grazing animals, I considered that any differences detected would indicate the effect of grazing intensity on the distribution and abundance of the local avifauna.

#### STUDY AREA AND METHODS

The country around Nathdwara is situated at 500-700 m above sea level, with a semi-arid climate, receiving more than 90% of its annual precipitation of c. 700 mm during the monsoon months of June to September (Basu 1965). During my stay from 1-8 November daily maximum temperatures ranged from 25-29°C

and daily minimum from 15-18°C. The 1983 monsoon was a good one, with rainfall higher than average over Rajasthan as a whole. Although no figures were available for Nathdwara it was clear from the state of tanks and reservoirs that precipitation had been abundant.

Observations were carried out on rocky hillsides with slopes exceeding 5° within 4 km of Nathdwara. The geology of the area consists of archaic rocks of the Aravalli system, locally consisting mainly of metamorphosed limestones. Over most of the area covered soils were very thin or non-existent, the only accumulations being in the valley bottoms which I did not include in my observations.

All observations consisted of paired line transects, one inside and one outside the walled enclosures. Each pair was carried out as close together in time and space as possible, so that they covered ground with the same slope, aspect and geology at the same time of day. I performed seven pairs of transects between 1 and 8 November 1983.

All transects lasted 15 minutes and covered about 0.5 km. Each involved walking slowly in a straight line between pre-selected points and counting all birds within an estimated 20 m of the transect route. A different area was selected for each transect so that no ground was covered more than once. Only birds seen perched on the ground or on vegetation were included, hence aerial insectivores, such as swallows, swifts and bee-eaters, were mainly ignored. Four pairs of transects were carried out between 0820-1035 hrs local time and three between 1615-1730 hrs.

#### RESULTS

##### *Vegetation*

No significant differences were found between the enclosed and unenclosed areas in the

dominant species of woody vegetation, the most important being *Euphorbia roylei*, *Acacia* spp. and *Zizyphus nummularia*. The proportion of ground area covered by shrubs and tree canopy was likewise similar, ranging from 5-20% in both treatments. Ground vegetation outside the enclosures consisted of a variety of herbs and grasses up to 0.2 m high, including several spinous perennial cushion plants. Ground cover ranged from 20-50%. Inside the enclosures the ground vegetation was dominated by grasses from 0.3-1.3 m high with ground cover ranging from 70-100%. In a few places inside the enclosures the grasses had been cut for hay, but these harvested areas amounted to no more than 10% of any transect.

*Species richness*

During the course of all transects twenty-one species of birds were recorded inside the enclosures and sixteen species outside. Only eight species were common to both treatments. Inside enclosures a mean of 6.29 + 1.98 (s.d.) species per transect was recorded, whereas outside the mean was 4.71 + 2.69 species per transect. Fourteen species were recorded on only one transect and only nine were recorded on three or more. This suggests that my samples were not adequate to record all the species potentially occurring in the area.

*Numbers of birds*

The mean numbers of birds of all species seen on transects within the enclosures was 13.57 + 7.35 birds per transect. Outside the enclosures the corresponding figure was 7.57 + 4.12 birds per transect, significantly lower ( $t=2.88$ , d.f. 12,  $P<0.05$ ). The difference is in the opposite direction to that which we might have anticipated considering the relative detectability of birds in the two treatments. Hence we can probably conclude that

bird densities are higher in the enclosures than outside them.

*Species composition*

Considering only those species recorded on three or more transects, it is evident that certain species showed a preference for a particular treatment (Table 1). Those exclusively re-

TABLE 1

NUMBERS OF TRANSECTS IN ENCLOSED AND UNENCLOSED AREAS ON WHICH THE NINE MOST COMMON SPECIES WERE RECORDED

Species	Enclosed	Unenclosed
Little Brown Dove <i>Streptopelia senegalensis</i>	6	3
Red-vented Bulbul <i>Pycnonotus cafer</i>	4	0
Large Grey Babbler <i>Turdoides malcolmi</i>	1	3
Indian Robin <i>Saxicoloides fulicata</i>	6	4
Brown Rock Chat <i>Cercomela fusca</i>	0	5
Pied Wheatear <i>Oenanthe picata</i>	0	6
Plain Wren-Warbler <i>Prinia subflava</i>	5	0
Rufous-fronted Wren-Warbler <i>Prinia buchanani</i>	4	0
Lesser Whitethroat <i>Sylvia curruca</i>	5	2

corded in the enclosures were the Red-vented Bulbul and the two species of Wren-Warbler. The Pied Wheatear and Brown Rock Chat, in contrast, were recorded exclusively on transects outside the enclosures. Only the three most numerous species; Little Brown Dove, Indian Robin and Lesser Whitethroat, were well represented in both treatments.

DISCUSSION

The results of my transects suggest that unrestricted grazing and a consequent dearth of ground vegetation on unenclosed areas lowers the number of birds present, at least at the

time of year when I made my observations. It also probably reduces the diversity of species and changes the habitat to suit ground-feeding birds, such as the Pied Wheatear and Brown Rock Chat, at the expense of Wren-Warblers and other species which favour dense vegetation.

The change from a luxuriant seasonal development of ground vegetation, as seen in the enclosures, to a very small amount of ground cover, as seen outside the enclosures, is one that must have taken place over large areas of India within the last millenium in response to the gradual increase in the human population and its domestic flocks. We can probably assume that this has led to a corresponding change in bird populations. For migrants the impact of these changes will also have been

experienced on their breeding grounds, where the size of breeding populations may have altered in response to changes in the availability of wintering habitat.

Because the well-vegetated enclosures appear to support a greater diversity of birds than unenclosed areas we can probably assume that an increase in grazing pressure has been associated with a general decline in the diversity of birds in areas supporting the type of semi-arid ecosystem characteristic of north-western and central India. I have already suggested elsewhere that the distribution of rare and local passerine birds in different ecogeographical regions of India and Pakistan provides evidence that such a process has been at work for some time (Gaston 1984).

CANADIAN WILDLIFE SERVICE,  
ENVIRONMENT CANADA,  
OTTAWA K1M 2A8,  
CANADA,  
December 13, 1983.

A. J. GASTON

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19. SIGNIFICANCE OF RESIDUAL EGG-FLUID TO HATCHING PATTERNS IN THE GHARIAL (*GAVIALIS GANGETICUS*) AND EMYDID FRESHWATER TURTLES (REPTILIA; CROCODILIA AND CHELONIA)

(With a text-figure)

INTRODUCTION

Reptiles were successful as land vertebrates over the amphibians mainly due to evolution

of the egg with extraembryonic fluid. Therefore, conservation and maintenance of this fluid all through the development from egg-laying to hatching is of high significance to a species.